

METHODS AND SYSTEMS OF NETWORK MANAGEMENT

RELATED APPLICATION

The present application claims priority to and the benefits of the prior-filed co-pending and commonly owned provisional application entitled "ADSL Network Management System", filed in the United States Patent and Trademark Office on August 27, 1999, assigned Application No. 60/151,120 and incorporated herein by reference.

FIELD OF THE INVENTION

The inventions described herein relate to the field of telecommunications, and particularly, relate to the provisioning and management of digital subscriber line (DSL) services such as asymmetric digital subscriber line (ADSL) services.

BACKGROUND

Fast access to the Internet. Many products and services advertise fast access to the Internet, and many deliver fast access, but only after the customer has been provisioned and otherwise set-up to receive and connect to the services for appropriate interface with the Internet. The actual "provisioning" and related

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Accordingly, there is a need for methods and systems that allow for the efficient, cost-effective, and speedy provisioning of a customer for services such as DSL service and the like, that connect the customer to the Internet or other global communications network.

SUMMARY

Generally, the methods and systems described herein provide a network management system (NMS) that can automatically model a path for a customer's services from the customer's terminating unit (TU) through elements typically on a link-by-link basis, across networks if appropriate, to a network service provider (NSP) or Internet service provider (ISP). The path may be referred to as a private virtual circuit or private virtual connection (PVC), and it may traverse an "overall network" including other networks such as an asymmetric digital subscriber line (ADL) service or sub-networks. To model a path for a customer's services, the NMS creates a topology or overall model including the elements and links in the overall network and respective features, functions, characteristics, and capacities thereof

Advantageously, the creation of a topology or overall model of the overall network allows the NMS to speedily, efficiently, and automatically provision a customer's service from the customer terminating unit to connection to the customer's selected NSP for Internet access. In addition, the creation of the topology allows the NMS to implement functions other than the modeling of a path for a customer's services. For example, the NMS may include fault management functions, diagnostic functions, capacity and inventory management functions, and service management

functions related to the elements, links, networks, and sub-networks of the overall network.

Further, the creation of the topology or overall model network allows for the automation of many of the previously mentioned actions so that many customers may be quickly and efficiently provisioned with services or other actions taken on a larger scale and more efficient than previously possible through the manual operations described in the background above.

That the present inventions and the exemplary embodiments accomplish the features of the present inventions will become apparent from the detailed description of the exemplary embodiments and the drawings that follow.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of an exemplary environment for operation of an exemplary NMS.

Fig. 2 is a block diagram illustrating an exemplary network creation in the NMS database.

Figs. 3A – 3M illustrate windows and other screen displays that may appear to or be used by a user of a graphic user interface (GUI) of an exemplary NMS in connection with fault management features or functions.

Figs. 4A – 4H illustrate windows and other screen displays that may appear to or be used by a user of a graphic user interface (GUI) of an exemplary NMS in connection with diagnostic functions or features.

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window 246 such as illustrated in Fig. 3M. The On-Line Window Adviser supplies details on the selected alert.

The exemplary NMS includes error logs, which are files that contain details of error or problems that have come up within the NMS. These logs can be referenced to discover details of any system-generated error condition. There are six exemplary error logs:

The logs may reside in a log directory in the exemplary NMS.

Diagnostic Functions of an Exemplary NMS

An exemplary NMS also includes diagnostic functions, which may be accessed by a user through use of a graphical user interface (GUI) of the NMS such as through the region-wide screen 178 as illustrated in Fig. 3A. The screen 178 includes an option for "Diagnostic" that may be selected by the user. The diagnostic functions allow the user to research port and PVC connections, and to determine the customers (or other end users) who may be affected by upstream actions.

If the user decides to proceed with diagnostic functions and selects "Diagnostic" from the region-wide screen 178, then a drop-down menu appears including the following features: Translate Port; Customer PVC; Find Circuit Name; Network PVC; and Find Affected End Users.

Fig. 4A illustrates a Translate Port Name window that allows a user to translate between and among the names of ports of elements in the equipment.

The Customer PVC function allows the user to have a network view of how a customer is connected to the overall network. For example, the Customer PVC function allows for the display of a window that includes the customer's VPI/VCI assignment, the COSMOS name, etc. To implement this function, the user may use the Diagnostic-Customer PVC window 242 as illustrated in Fig. 4B. The window 242 includes a customer ID field for the customer's telephone number or other identifier. If this field is populated, then the other field in the window 242, the PVC ID, populates. The user then may proceed to obtain additional information by

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viewed and accessed through the Capacity management-Thresholds window 276 such as illustrated in Fig. 5D. The thresholds are global default values for all DSLAMs, preferably. Threshold alarms are generated under the following conditions:

- Actual percentage use is greater than threshold available ADSL = alert
- Actual number of available ports is less than threshold for available ADSL port = alert.

To display the window 276, the user selects Inv/CapcityMgmt from the region-wide screen 178, then selects Edit Capacity Threshold, and then Default DSLAM/Mini-Ram. The Capacity Management – Thresholds window 276 may be used to set the default port availability threshold and saturation thresholds for a CO DSLAM, remote DSLAM, or Mini-Ram. The values illustrated in window 276 are exemplary default values. In the Available Port Threshold: field of the window 276, the value is an absolute number. In the Saturation Threshold field of the window 276, the value is a percentage of 576, which is the maximum capacity of a DSLAM. This value could reasonably be increased to 80%.

The Per DSLAM option brings up the Capacity Management Thresholds window 278 such as illustrated in Fig. 5E. This window 278 may be used to set the default port availability threshold and saturation thresholds for a specific CO DSLAM/remote DSLAM. Percentage utilization = (number of cross-connected ports)

1. When an alarm is enabled, the systems produces alarms any time the threshold is reached.

The Per Mini-Ram option brings up the DSLAM/Mini-Ram Port Inventory window 282 as illustrated in Fig. 5G. When the CLLI is entered in the CLLI field, the information populates as shown in the window 282 including type; COSMOS/LFACS; Assigned; Status; Denied; and Subtending. ADSL Port is in the configuration of (for example):

- STMNGAMNH01-1-1-2-1, where the first 121 characters represent the DSLAM CLI; and the next 4 digits, the rack, shelf, card, and port.

COSMOS port is in the configuration (for example):

- ADS130100-01-061, where the first 7 characters represent the DSLAM CLI; the next 3 are the rack, shelf, and card.

Cross-connect status will either be OOS (Out of Service) or IS (In Service). This status is collected from the NMS.

Port status is either OOS-AU, OOS-AUMA, OOS-MA, IS-NR, or blank (if it is administratively out of service =denied service]). OOS indicates that no ATUR is connected; IS indicates connection.

The DSLAM/Mini-Ram Card Inventory menu selection brings up the DSLAM/Mini-Ram Card Inventory window 284 such as illustrated in Fig. 5H. The window 284 displays the inventory of DSLAMs, remote DSLAMs, or Mini-Rams. The card inventory contains information, such as the software version and vendor information. In the exemplary window 284 of Fig. 5H, the window includes data

such as card number; type; SW version; vendor; serial number; and status. To display the desired information, the CLLI is entered and the fields populate.

Service Management

The exemplary NMS may include service management functions to manage bulk PVC, deny, restore, or edit service, edit a customer's record, delete a service order, and modify the customer's profile. The service management functions include seven features that may be accessed via a drop-down menu from the option "Service" on the region-wide screen 178 as follows: Bulk PVC; Deny Service; Response Service; Edit Service; Edit Customer Record, Delete Service Order, ATUR-NSP; and ATUR-Service Gateway.

For the Bulk PVC feature, three menu selections appear on a further drop-down menu as follows: Add Bulk PVC; Edit Bulk PVC; and Delete Bulk PVC. In particular, if the user selects the Add Bulk PVC, then window 286 as illustrated in Fig. 6A appears. The bulk PVC is used to move all logical circuits from one physical link to another. The new ATM port changes the physical link Z end point. All PVCs are moved on the due date. Failure to move any PVC generates an alert. The bulk PVC order can be edited using the Edit Bulk PVC menu option which generates the window 288 as illustrated in Fig. 6B. To edit, a service order number is selected from the pick list in the Order Number field, and then the Edit Bulk PVC window 290 as illustrated in Fig. 6C appears. In window 290, in the Old NSP CID field, the old NSP circuit ID is entered. IN the CLLI field, the CLLI is entered. The rack and shelf fields contain default values and are skipped. In the Slot field, the slot number is

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The Modify a Customer's Profile feature is used to reduce a customer's ADSL connections speed to a maintenance mode. For Modifying a Customer's Profile feature, if the Modify Customer's Profile option is selected, then window 306 such as illustrated in Fig. 6K displays. The Customer ID field is filled with the customer's telephone number, and then the pick list field in the PVC ID field populates with a PVC selection. The user may click on the triangle in the window 306, and select a PVC from the list that displays. The maintenance profile (Maint) then may be selected from the list.

The above description included details about exemplary network creation in the NMS database. The exemplary NMS allows for the deletion of network elements from the network. Interdependent elements may be deleted in the NMS database in the following sequence:

- ATLLIB01 1022548.1

- Mini-Ram
- NSP; DSLAM; ATM switch
- Remote site
- Location (type Building Location, NSP)

Individual components of a network element generally may not be deleted. The deletion of a DSLAM causes the automatic deletion of all of its associated racks, shelves, cards, and physical ports.

The drop-down menus for deleting network elements are accessed through the region-wide screen 178, and particularly, through use of the NetworkCreation option on the region-wide screen 178.

To delete a physical link, the NetworkCreation option leads to a drop-down menu that includes Physical Link, which should be selected, and then the Delete Physical Link option should be selected. The Delete Physical Link window 308 as illustrated in Fig. 7A appears. In the Circuit ID field, the circuit ID may be entered. The data then is committed to the database.

To delete an NSP, certain prerequisites must have been satisfied: it must be verified that all PVCs have been disconnected from the NSP to the DSLAM; and it must be verified that each physical link connecting the NSP to the ATM network is deleted from the NMS. Once these prerequisites have been satisfied, then to delete an NSP, the NetworkCreation option leads to a drop-down menu that includes NSP, which should be selected, and then the Delete NSP should be selected. The Delete

NSP Location window 310 appears as illustrated in Fig. 7B. In the NSP field, the NSP name is entered, and the CLLI field populates. The delete is committed to the database.

To delete a DSLAM or a Mini-Ram, certain prerequisites must be satisfied: it must be verified that the DSLAM or Mini-Ram as a whole does not support any ATM PVCs; no PVCs should exist on the DSLAM or Mini-RAM; all customers assigned to the DSLAM must be disconnected; all PVCs must be removed before any further action can take place; the physical link, connecting the DSLAM to the ATM network must be deleted; and the physical port on the edge of the ATM network that terminated the physical link must be deleted. Once these prerequisites have been satisfied, then to delete a DSLAM or a Mini-RAM, the NetworkCreation option leads to a drop-down menu that includes DSLAM/Mini-Ram, which should be selected, and then the Delete DSLAM/Mini-Ram should be selected. The Delete DSLAM/Mini-Ram window 312 appears as illustrated in Fig. 7C. In the CLLI field, the CLLI code is entered, and the delete is committed to the database.

To delete an ATM switch, the NetworkCreation option leads to a drop-down menu that includes ATM, which should be selected, then the ATM Switch, and then the Delete ATM Switch. The Delete ATM Switch window 314 appears as illustrated in Fig. 7D. In the CLLI field, the CLLI code is entered, and the delete is committed to the database.

To delete a Remote Site, the NetworkCreation option leads to a drop-down menu that includes Remote Side, which should be selected, and then the Delete Remote Side. The Delete Remote Side window 316 appears as illustrated in Fig. 7E.

In the CLI field, the CLI code is entered, and the delete is committed to the database.

To delete a building location, the NetworkCreation option leads to a drop-down menu that includes Building Location, which should be selected, and then the Delete Building Location. The Delete Building Location window 318 appears as illustrated in Fig. 7F. In the CLI field, the CLI code is entered, and the delete is committed to the database. However, the location may not be deleted if the location has any DSLAM or ATM switch associated with the location; or if the location has any physical ports associated with it that are associated with physical links. Deleting a location also deletes the ATM physical port on the ATM network that is associated with the location. These ports have no associated physical links.

From the foregoing description of the exemplary embodiments of the present inventions and operations thereof, other embodiments will suggest themselves to those skilled in the art. Therefore, the scope of the present invention is to be limited only by the claims below and equivalents thereof.